Amendments to the Specification:

Please replace paragraphs [0053] – [0062] with the following amended paragraphs:

[0053] Referring to FIG. 3A, a printed circuit board 100 according to the present invention has a substrate 110 and [[PCB]] a plurality of land groups 120 that electrically connect ~~connects~~ the substrate 110 to external circuit elements ~~outside~~. Also, a driving circuit is formed on the printed circuit board 100 for operating the liquid crystal display device.

[0054] The [[PCB]] land groups 120 are [[is]] composed of a plurality of PCB land groups [[lands]] 120a through 120h, to each of which a corresponding one of a plurality of tape carrier packages (TCPs) is to be attached. As illustrated in FIG. 3A, each [[Each]] of the PCB land groups 120a to 120h has a lateral position that is "shrunk", or contracted, by a predetermined dimension ~~(hereinafter it is called the shrinkage design)~~ in the direction of a point M located on a line perpendicular to the long edge of the PCB (phantom line in FIG. 3A) dividing the substrate 110 into two parts along the length of the substrate 110 relative to the respective lateral positions of corresponding ones of the land groups of the conventional printed circuit board 30 of FIG. 2. The PCB land groups [[lands]] 120a through 120h are respectively defined as [[a]] first to eighth PCB land groups 120a to ~~a eighth PCB land~~ 120h, and span from the left side to the right side of the substrate 110. Also, an anisotropic conductive film (ACF) 130 is attached to the upper surfaces of the PCB land groups [[lands]] 120a through 120h.

[0055] The length of the printed circuit board 100 of particular interest here is ~~generally indicated as~~ the right-to-left, or lateral distance from the right end of the eighth PCB land group 120h (corresponding to an [[a]] eighth tape carrier package TCP 8) to the left end of the first PCB land group 120a (corresponding to a first tape carrier package TCP 1). Thus, [[So]] the printed circuit board 100 of the present invention, together with the land groups 120 disposed thereon, (hereinafter referred to as a "shrinkage" printed circuit board) has a length that is [[the]] shrunk, or contracted, ~~length (hereinafter, the printed circuit board 100 is called as a shrinkage printed circuit board),~~ when compared to the conventional printed circuit board 30 of FIG. 2.

[0056] In accordance with one exemplary embodiment of the present invention, the amount that ~~The shrinkage amount of~~ the shrinkage printed circuit board 100 is shrunk is determined by

the degree of misalignment of the land groups 120 occurring ~~happening~~ in the conventional printed circuit board 30 when a typical thermo-compression bonding process is applied thereto ~~according to one embodiment of the present invention~~. For this purpose, after a [[the]] conventional printed circuit board 30 having a thickness of about 0.45[[t]] mm was thermo-compressed under a pressure of about 172 kg f/cm2 for about 20 seconds, the degree of misalignment between each land group 120 and its corresponding TCP was ~~were respectively~~ measured at the left and the right ends of each land group 120, and the measurements were tabulated, ~~the TCP~~ as shown in Table 1. In the above thermo-compression bonding process, Samples 1 – 4 , ~~Sample 2 and Sample 3~~ were respectively bonded by the foregoing thermo-compression bonding method at temperatures of about 415° C., ~~about~~ 405° C., ~~about~~ 415° C. and ~~about~~ 420° C, respectively. FIG. 4 illustrates [[the]] graphs in which ~~according to~~ the results for each of the Samples 1-4 shown in Table 1 are respectively plotted.

[0057] As shown in FIG. 2, in the conventional printed circuit board 30, the first TCP 50 and the eighth TCP 50 respectively experience the greatest amount of lateral expansion ~~are expanded the most~~ due to [[the]] thermal expansion. Referring to FIG. 4, it may be seen that the degree of land group 120 misalignment tends to increase toward the right upper ends of the graphs, and that the greatest amount of misalignment occurs at ~~a lot in~~ the left of the point M dividing the printed circuit board into the two portions rather than at the right of the point M. The reason for this is that the respective thermal reaction properties of [[in]] the left and the right portions of the printed circuit board 30 are different from each other, since the conventional printed circuit board 30 is not symmetrical about the line (phantom line of FIG. 2) passing through the point M ~~symmetric in left and right~~.

[0058] Referring to Table 1 and FIG. 4, it may be seen that [[the]] TCP 1 and [[the]] TCP 8 experience the most misalignment ~~are misaligned most~~. The amount of shrinkage of the PCB land groups 120a and 120h [[lands]] respectively corresponding to [[the]] TCP 1 and [[the]] TCP 8 needed to compensate for this misalignment can be determined from Table 1 and the graphs of FIG. 4. Hence, the shrinkage printed circuit board 100 is formed by positioning the land groups of the PCB so as ~~determining the positions of other PCB lands~~ to have respective constant intervals in each of the left portion and the right portion of the shrinkage printed circuit board 100,

based on the shrinkage of the PCB land groups 120 a and 120h [[lands]] respectively corresponding to [[the]] TCP 1 and [[the]] TCP 8, as described in more detail below.

[0059] According to Table 1, the average misalignment of the regions where [[the]] TCP 1 and [[the]] TCP 8 are located ~~positioned~~ are – 69.375 μm and 43.875 μm, respectively. Also, since the degree of misalignment in the left portion of the conventional printed circuit board 30 is greater ~~higher~~ than in the right portion of the printed circuit board, as shown in FIG. 4, the PCB land group 120a corresponding to [[the]] TCP 1 [[1200a]] is shrunk toward the point M by ~~the dimension of~~ about 66.5 μm, with ~~under~~ a [[the]] processing allowance of about 2.875 μm, and the PCB land group 120h corresponding to [[the]] TCP 8 [[200h]] is shrunk by ~~the dimension of~~ about 46.5 μm toward the point M, with ~~under~~ a [[the]] processing allowance of about 2.125 μm. Thus, [[so]] the shrinkage printed circuit board 100 has a length of interest dimension that is [[the]] shrunk ~~dimension~~ by ~~the length of~~ about 112.5 μm in comparison with that of the conventional printed circuit board 30.

[0060] Also, since the amount of thermal expansion ~~amount~~ of the left portion of the shrinkage printed circuit board 100 is greater ~~larger~~ than the amount of thermal expansion ~~amount~~ of the right portion thereof ~~the shrinkage printed circuit board 100~~, which, as discussed above, is a result of the asymmetry ~~depending on the shape~~ of the shrinkage printed circuit board 100, [[so that]] the intervals between ~~distances among~~ the respective PCB land groups [[lands]] are set at [[as]] 19 μm in the [[left]] portion of the PCB left of the point M and at 13 μm in the [[right]] portion of the PCB right of the point M.

[0061] Hence, in accordance with one exemplary embodiment of the present invention, in order to improve [[this]] the TCP lead group – PCB land group misalignment problem of the conventional PCB 30 ~~according to the one embodiment of the present invention~~, the dimensions of the intervals between the land groups ~~dimensions~~ of the conventional PCB [[lands]] are shrunk as shown in FIG. 3A and described above, so that the shrinkage printed circuit board 100 has a length of interest dimension that is shrunk ~~the shrunk length~~ by 112.5 μm, as compared with the corresponding length of interest dimension of the conventional printed circuit board 30.

[0062] Referring to FIG. 3B, the TCP units 200 respectively corresponding to the PCB land groups [[group]] 120 are [[is]] fixed at respective [[the]] edge portions of the TFT substrates 300

by interposing the ACF 250 therebetween. The ACF 250 is the medium that electrically connects the TCP units 200 to the TFT substrate 300. The TCP units 200 ~~corresponds~~ correspond to respective ones of the PCB land groups [[lands]] 120a through 120h, and starting at the left side of the figure, comprise ~~and consists of the~~ first to eighth TCPs 200a through ~~the eighth TCP~~ 200h ~~from the left of the TCP unit~~.

Please replace paragraph [0064] with the following amended paragraph:

[0064] In this case, each of the TCPs 200a through 200h is disposed at ~~formed by~~ a predetermined interval to align in the position, before each PCB land group 120a through 120h respectively corresponding to each of the TCPs 200a through 200h is shrunk. ~~Hereinafter, the portion of the shrinkage printed circuit hoard 100 where the input lead 230 and the output lead 240 are installed is called a horizontal portion while the portion of the shrinkage printed circuit hoard 100 perpendicular to the horizontal portion is called a vertical portion~~.

Please replace paragraphs [0067] – [0069] with the following amended paragraphs:

[0067] At that time, the PCB land groups [[lands]] 120a through 120h respectively move ~~are expanded~~ toward the left and the right ends of the substrate 110 centering around the point M according to the thermal expansion of the substrate 110 to compensate for the respective amounts of shrinkage ~~amount of~~ that each PCB land group 120a through 120h was shrunk when the shrinkage printed circuit board 100 was [[is]] manufactured. Thus, the degree of misalignment decreases ~~is decreased~~ during thermo-bonding, since each PCB land group 120a through 120h expands so as to move into alignment ~~are well aligned~~ with its corresponding TCP 200 ~~to each TCP 200a through 200k~~.

[0068] For verifying the misalignment, the shrinkage printed circuit boards are measured after selecting ~~arbitrary~~ ten shrinkage printed circuit boards at random and putting them through the thermo-compression bonding process described above. Each shrinkage printed circuit board has a thickness of about O.45 mm [[t]] and is thermo-compressed at a temperature of about 175° C under a pressure of about 3 MPa for about 20 seconds.

[0069] The directions of the left and the right thermal expansion ~~directions~~ of the left and right ends of [[the]] TCPs 200a through 200h are different from the directions of thermal expansion ~~direction~~ of the substrate 110. Therefore, individual misalignment occurs to the left and right directions of the TCPs 200a through 200h. Therefore, [[So]] the respective left misalignments of the TCP units 200 and the respective right misalignments of the TCP units 200 are independently measured, as shown in Table 2.

Please replace paragraph [0073] with the following amended paragraph:

[0073] Also, as ~~will be~~ described below, the total amount of thermal expansion ~~amounts~~ of each [[the]] tape carrier package is assumed ~~packages can be presumed~~ to have a constant value (= 2β) ~~values~~ that is independent of the expansion of either ~~concerning~~ the shrinkage printed circuit board 100 or the conventional printed circuit board 30 during the thermo-compression bonding process.

Please replace paragraphs [0077] – [0098] with the following amended paragraphs:

[0077] Referring to FIG. 5A, the direction of expansion ~~direction~~ of the left end of the first TCP 200a is identical to the direction of expansion ~~direction~~ of the shrinkage printed circuit board 100. However, the direction of expansion ~~direction~~ of the left end of the eighth ~~eight~~ TCP 200h is opposite to the ~~expansion~~ direction of expansion of the shrinkage printed circuit board 100. FIG. 5B is a plane view illustrating the measurement of the misalignment of the A region in FIG. 5A. FIG. 5C is a plane view illustrating the measurement of the misalignment of the B region in FIG. 5A.

[0078] In FIG. 5B, a first real line 410 corresponds to ~~means~~ the left end of the first PCB land group 120a in the pre-compression state and a second real line 510 corresponds to ~~indicates~~ the left end ~~portion~~ of the first TCP 200a in the pre-compression state. Thus, the distance between the first real line 410 and the second real line 510 corresponds to the pre-adjustment made in the pre-compression state of the shrinkage printed circuit board 100 by shrinking the position of the first PCB land group 120a toward the point M, as described above.

[0079] When the thermo-compression ~~pre-compression~~ process is performed on ~~concerning~~ the first TCP 200a and the first PCB land group 120a, the left end of the first PCB land group 120a moves toward a first dotted line 420 due to the thermal expansion of the substrate 110 [[100]] and the left end ~~portion~~ of the first TCP 200a also moves toward the second dotted line 520 for the same reason. Hence, after the thermo-compression bonding process, the first TCP 200a is expanded by an interval $(-\beta)$ [[(V1)]]) between the second real line 510 and the second dotted line 520. Also, the first PCB land group 120a expands by an interval (P_1) between the first real line 410 and the first dotted line 420. Then, the measured misalignment value becomes the interval (A_1) from the second dotted line 520 to the first dotted line 420. ~~Therefore, the magnitude of the misalignment (A_1) measured at the left portion of the first TCP 200a is expressed according to the following equation (2):~~

~~$$A_1 = -P_1 - (-\alpha) \qquad (2)$$~~

[0080] In Table 2, since the left misalignment value of the first TCP 200a is – 28, the left end of the first PCB land group 120a is positioned at a position that is offset ~~departed~~ from the left end ~~portion~~ of the first TCP 200a by about 28 μm toward the left direction after thermal expansion of the substrate 100.

[0081] In FIG. 5C, the first real line 610 corresponds to ~~means~~ the left end of the eighth PCB land group 120h in the pre-compression state and the second real line 710 corresponds to ~~indicates~~ the left end ~~portion~~ of the eighth TCP 200h in the pre-compression state. Thus, the distance between the first real line 610 and the second real line 710 corresponds to the pre-adjustment made in the pre -compression state of the shrinkage printed circuit board 100 by shrinking the position of the eighth PCB land group 120h toward the point M, as described above.

[0082] When the thermo-compression ~~pre-compression~~ process is performed on ~~concerning~~ the eighth TCP 200h and the eighth PCB land group 120h, the left end of the eighth PCB land group 120h moves toward the first dotted line 620 due to the thermal expansion of the substrate 110 [[100]] and the left end ~~portion~~ of the eighth TCP 200h also moves toward the second dotted line 720 due to the thermal expansion of the substrate [[100]]. Hence, after the thermo-compression bonding process, the eighth TCP 200h is expanded by an interval $(-\beta)$ ~~(α)~~ between the second real line 710 and the second dotted line 720. The eighth PCB land group 120h also

expands by an interval (P_8) between the first real line 610 and the first dotted line 620. Also, the measured misalignment value becomes the interval (A_8) from the second dotted line 720 to the first dotted line 620. ~~Therefore, the magnitude of the misalignment (A_8) measured at the left portion of the eighth TCP 200h is expressed according to the following equation (3):~~

~~$$A_8 = P_8 - (-\alpha) \quad (3)$$~~

[0083] In Table 2, since the left misalignment value of the eighth TCP 200h is 82, the left end of the eighth PCB land group 120h is positioned at a position that is offset ~~departed~~ from the left end ~~portion~~ of the eighth TCP 200h by about 82 μm in the right direction after thermal expansion of the substrate 110 [[100]].

[0084] ~~Hence, the following equation (4) can be obtained by taking the equation (2) from the equation (3):~~

~~$$A_8 - A_1 = P_8 + P_1 \quad (4)$$~~

[0085] The ~~Therefore, the~~ difference between the misalignment values measured at the respective left ends ~~portions~~ of the first TCP 200a and the eighth TCP 200h is regarded as the total amount of thermal expansion ~~amount~~ of the shrinkage printed circuit board 100 occurring ~~generated~~ during the thermo-compression bonding process.

[0086] FIGS. 6A, 6B, and 6C are plane views illustrating the presumption of the total amount of thermal expansion ~~amount~~ of the shrinkage printed circuit board 100 concerning the measured amounts of misalignment ~~amounts~~ based on the respective right ends ~~portions~~ of the TCP units 200.

[0087] Referring to FIG. 6A, the direction of expansion ~~direction~~ of the right end of the first TCP 200a is opposite to the direction of expansion ~~direction~~ of the shrinkage printed circuit board 100. However, the direction of expansion ~~direction~~ of the right end of the eighth TCP 200h is identical to the direction of expansion ~~direction~~ of the shrinkage printed circuit board 100. FIG. 6B is a plane view illustrating the measurement of the misalignment of the C region in FIG.

6A. ~~FIGS. 6A and~~ FIG. 6C is a plane view illustrating the measurement of the misalignment of the D region in FIG. 6A.

[0088] In FIG. 6B, the first real line 430 corresponds to ~~means~~ the right end of the first PCB land group 120a in the pre-compression state and the second real line 530 corresponds to ~~indicates~~ the right end ~~portion~~ of the first TCP 200a in the pre-compression state. Thus, the distance between the first real line 430 and the second real line 530 corresponds to the pre-adjustment made in the pre-compression state of the shrinkage PCB by shrinking the position of the first PCB land group 120a toward the point M.

[0089] When the thermo-compression ~~pre-compression~~ process is performed on ~~concerning~~ the first TCP 200a and the first PCB land group 120a, the right end of the first PCB land group 120a moves toward the first dotted line 440 due to the thermal expansion of the substrate 110 [[190]] and the right end ~~portion~~ of the first TCP 200a also moves toward the second dotted line 540 for the same reason. Hence, after the thermo-compression bonding process, the first TCP 200a expands by an interval (W1) between the second real line 530 and the second dotted line 540, and the first PCB land group 120a corresponding to the first TCF 200a expands by an interval (P1) between the first real line 430 and the first dotted line 440. ~~Then, the measured misalignment value becomes the interval (B1) from the second dotted line 540 to the first dotted line 440. Therefore, the magnitude of the miss-alignment (B1) measured at the right portion of the first TCP 200o is expressed according to the following equation (5):~~

~~$$B_1 = P_1 - (W_1) \qquad (5)$$~~

[0090] In Table 2, since the right misalignment value of the first TCP 200a is – 64, the right end of the first PCB land group 120a is positioned at a position that is offset ~~departed~~ from the right end ~~portion~~ of the first TCP 200a by about 64 μm in the left direction after thermal expansion of the substrate 110 [[100]].

[0091] In FIG. 6C, the first real line 630 corresponds to ~~means~~ the right end of the eighth PCB land group 120h in the pre-compression state and the second real line 730 corresponds to ~~indicates~~ the right end ~~portion~~ of the eighth TCP 200h in the pre-compression state. Thus, the

distance between the first real line 630 and the second real line 730 corresponds to the pre-adjustment made in the pre-compression state of the shrinkage PCB 100 by shrinking the position of the eighth PCB land group 120h toward the point M.

[0092] When the thermo-compression ~~pre-compression~~ process is performed on the eighth TCP 200h and the eighth PCB land group 120h corresponding to the eighth TCP 200h, the right end of the eighth PCB land group 120h moves toward the first dotted line 640 due to the thermal expansion of the substrate 110 [[100]] and the right end ~~portion~~ of the eighth TCP 200h also moves toward the second dotted line 740 for the same reason. Hence, after the thermo-compression bonding process, the eighth TCP 200h is expanded by an interval (W8) between the second real line 730 and the [[. The]] second dotted line 740, and the eighth PCB land group 120h expands by an interval (P8) between the first real line 630 and the first dotted line 640. Also, the measured misalignment value becomes the interval (B_8) from the second dotted line 740 to the first dotted line 640. ~~Therefore, the magnitude of the misalignment (B3) measured at the right portion of the eighth TCP 200k is expressed according to the following equation (6):~~

~~$$B_8 = P_8 - (W_8) \quad (6)$$~~

[0093] In Table 2, since the right misalignment value of the eighth TCP 200h is 38, the right end of the eighth PCB land group 120h is positioned at a position that is offset ~~departed~~ from the right end ~~portion~~ of the eighth TCP 200h by about 38 μm in the right direction after the thermal expansion of the substrate 110.

[0094] ~~Hence, the following equation (7) can be obtained by taking the equation (5) from the equation (6):~~

~~$$B_8 - P_8 = P_8 - (W_8) \quad (7)$$~~

[0095] The ~~Therefore, the~~ difference between the misalignment values measured at the respective right ends ~~portions~~ of the first TCP 200a and the eighth TCP 200h is regarded as the total amount of thermal expansion ~~amount~~ of the shrinkage printed circuit board 100 occurring ~~generated~~ during the thermo-compression bonding process.

[0096] FIGS. 7A and 7B are plane views showing the relative position between the respective PCB land groups and the corresponding TCPs of ~~concerning~~ Sample 1 in Table 2 after the thermo-compression bonding process. FIG. 7A is a plane view illustrating the alignment state between the first PCB land group and the first TCP 200a and FIG. 7B is a plane view showing the alignment state between the eighth PCB land group 120h and the eighth TCP 200h.

[0097] Referring to FIGS. 7A and 7B, the total amount of thermal expansion ~~amount~~ of the shrinkage printed circuit board 100 is directly obtained by taking the measured misalignment value of the eighth TCP 200h from the measured misalignment value of the first TCP 200a.

[0098] ~~In this case,~~ However, although the total amount of ~~though the~~ thermal expansion occurring ~~occurs~~ in the [[same]] shrinkage printed circuit board is obtained as above, the amount of thermal expansion ~~amount~~ on the left of the TCP unit ~~(see the equation (4))~~ differs from the amount of thermal expansion ~~amount~~ on the right of the TCP unit ~~(see the equation (7)).~~ due [[Due]] to the asymmetry of the shrinkage printed circuit board 100 about the point M. [[,]] Such [[such]] difference may cause [[the]] minute differences in the spacing between ~~among~~ the TCP units 200 ~~presumed acceptable as they have identical values~~ and [[the]] these spacing differences ~~among the thermal reaction properties of the TCP unit, causes~~ can cause processing errors.

Please replace paragraphs [0120] – [0124] with the following amended paragraphs:

[0120] In the exemplary shrinkage printed circuit board 100 of ~~according to~~ the present invention, the intervals between ~~among~~ the PCB land groups 120a to 120h [[lands]] respectively located at the left and the right portions of the substrate 110 centering around the point M are arranged so as to be different from one another ~~differently set one after another~~, thereby ~~constantly~~ maintaining the amount of misalignment ~~amount~~ generated in each of TCP 200a through 200h constant. The amount of this constant misalignment ~~amount~~ is obtained in the following manner ~~will be identified as follows by~~ utilizing the measured data in Tables 2 and 4.

[0121] In Table 2, the amount of misalignment ~~amount~~ is measured on the basis of each edge of TCP 200a through 200h for [[the]] convenience of [[the]] measurement. However, the precise

amount of misalignment ~~amount~~ should be measured on the basis of each PCB land group 120a through 120h and the center of each corresponding lead group of the TCPs 200a through 200h because [[the]] misalignment here means an [[the]] irregularity among the respective conductive patterns (*i.e.*, a misalignment between respective PCB land groups 120 and corresponding TCP 200 lead groups) that are used for exchanging the electrical signals between the printed circuit board 100 and the tape carrier packages 200.

[0122] Therefore, after the respective widths of each PCB land group 120a through 120h and the corresponding lead group of each TCP [[lead]] 200a through 200h are measured, the calculated misalignment values on the basis of the center of the lead group of each TCP [[lead]] 200a through 200h are presented in Table 7. In the samples of shrinkage printed circuit board 100 measured, the measured width of each PCB land group 120a to 120h and the measured width of each TCP lead group 200a to 200h are shown in the following Table 6.

[0123] As shown in Table 6, the measured width of each [[the]] land group is obtained by measuring the real width of the PCB land group of each sample and the width of the lead group is obtained by measuring the real width of the lead group of the corresponding TCP [[lead]] of each sample. The widths of the respective lead groups were found to vary only minutely, ~~leads are minutely various~~ so that the respective widths of the lead groups can be ~~leads are~~ treated as constants for all of the samples.

[0124] Thus, although the difference between the measured width of a [[the]] land group and the width of the corresponding lead group (hereinafter, ~~it is called~~ the width difference) is a quantity ~~the value~~ having no connection with the misalignment, the width difference is included in the measured misalignment value in Table 2. The measured misalignment values in Table 2 are obtained on the basis of each TCP 200a through 200h and each TCP 200a through 200h is thermally expanded in the left and the right directions centering around the point dividing each TCP 200a through 200h into two portions in the lengthwise direction of each TCP 200a through 200h. So two halves of the width difference are respectively included in the left and the right portions of each TCP 200a through 200h centering around the point dividing the lead group of

each TCP [[lead]] into two portions in the lengthwise direction of the lead group of each TCP [[lead]].

Please replace paragraphs [0126] with the following amended paragraph:

[0126] The following Table 9 shows the misalignment values amended on the basis of the center of the lead group of each TCP [[lead]] by using the misalignment amounts measured on the basis of the end portions of each TCP in Table 4 according to the above-described method. In this case, the measured values of each PCB land group and each corresponding TCP lead group are presented in Table 8.

Please replace paragraphs [0130] with the following amended paragraph:

[0130] Hence, the respective intervals among the PCB land groups [[lands]] at the left portion of the shrinkage printed circuit board 100 are set differently ~~set~~ from the respective intervals among the PCB land groups [[lands]] at the right portion of the shrinkage printed circuit board 100, thereby maintaining the magnitudes of the misalignment generated in each TCP 200a through 200h to have constant values after the thermo-compression bonding process. Also, this prevents ~~it can be prevented that the~~ excessive thermal expansions of each TCP 200a through 200h generated by the accumulation of ~~accumulating~~ the respective thermal expansions thereof ~~in the first TCP 200a and the eighth TCP 200h~~.

Please replace paragraphs [0146] with the following amended paragraph:

[0146] At first, after the anisotropic conductive film (not shown) is attached to the data and the gate input pads, the output ends of the tape carrier packages 70 and 90 are positioned on the surface of the anisotropic conductive film, and then the surfaces of the tape carrier packages 70 and 90 are pressed by using a thermo-compression device. Thus, the gate and the data input pads and the output leads (not shown) of the tape carrier packages 70 and 90 are electrically connected while the anisotropic conductive film composed of the thermoplastic resin is completely compressed to the liquid crystal display panel 50 by the thermo-compression device.

Please replace paragraphs [0150] with the following amended paragraph:

[0150] According to the present invention, when the PCB land groups [[lands]] are thermo-compressed with tape carrier packages by shrinking the PCB land groups [[lands]] of the printed circuit board by the thermal expansion of the printed circuit board, the misalignment between

respective PCB land groups and corresponding TCP lead groups due to the thermal expansion of the printed circuit board can be decreased to ~~sufficiently~~ secure a sufficient [[the]] processing margin, so that [[the]] productivity is ~~can be~~ improved by reducing the number of processing failures. Also, the amount of misalignment ~~amount~~ can be uniformly maintained so as to enhance the probability for controlling the misalignment and to increase the stability of the product.

Restatement of Amended Paragraphs of the Specification

For the Examiner's convenience, following is a restatement of the amended paragraphs of the specification, with the amendments made thereto incorporated therein.

[0053] Referring to FIG. 3A, a printed circuit board 100 according to the present invention has a substrate 110 and a plurality of land groups 120 that electrically connect the substrate 110 to external circuit elements. Also, a driving circuit is formed on the printed circuit board 100 for operating the liquid crystal display device.

[0054] The land groups 120 are composed of a plurality of PCB land groups 120a through 120h, to each of which a corresponding one of a plurality of tape carrier packages (TCPs) is to be attached. As illustrated in FIG. 3A, each of the PCB land groups 120a to 120h has a lateral position that is "shrunk", or contracted, by a predetermined dimension in the direction of a point M located on a line perpendicular to the long edge of the PCB (phantom line in FIG. 3A) dividing the substrate 110 into two parts along the length of the substrate 110 relative to the respective lateral positions of corresponding ones of the land groups of the conventional printed circuit board 30 of FIG. 2. The PCB land groups 120a through 120h are respectively defined as first to eighth PCB land groups 120a to 120h, and span from the left side to the right side of the substrate 110. Also, an anisotropic conductive film (ACF) 130 is attached to the upper surfaces of the PCB land groups 120a through 120h.

[0055] The length of the printed circuit board 100 of particular interest here is the right-to-left, or lateral distance from the right end of the eighth PCB land group 120h (corresponding to an eighth tape carrier package TCP 8) to the left end of the first PCB land group 120a (corresponding to a first tape carrier package TCP 1). Thus, the printed circuit board 100 of the present invention, together with the land groups 120 disposed thereon, (hereinafter referred to as a "shrinkage" printed circuit board) has a length that is shrunk, or contracted, when compared to the conventional printed circuit board 30 of FIG. 2.

[0056] In accordance with one exemplary embodiment of the present invention, the amount that the shrinkage printed circuit board 100 is shrunk is determined by the degree of misalignment of the land groups 120 occurring in the conventional printed circuit board 30 when a typical

thermo-compression bonding process is applied thereto. For this purpose, after a conventional printed circuit board 30 having a thickness of about 0.45 mm was thermo-compressed under a pressure of about 172 kg f/cm2 for about 20 seconds, the degree of misalignment between each land group 120 and its corresponding TCP was measured at the left and the right ends of each land group 120, and the measurements were tabulated, as shown in Table 1. In the above thermo-compression bonding process, Samples 1 – 4 were respectively bonded by the foregoing thermo-compression bonding method at temperatures of about 415° C, 405° C, 415° C and 420° C, respectively. FIG. 4 illustrates graphs in which the results for each of the Samples 1-4 shown in Table 1 are respectively plotted.

[0057] As shown in FIG. 2, in the conventional printed circuit board 30, the first TCP 50 and the eighth TCP 50 respectively experience the greatest amount of lateral expansion due to thermal expansion. Referring to FIG. 4, it may be seen that the degree of land group 120 misalignment tends to increase toward the right upper ends of the graphs, and that the greatest amount of misalignment occurs at the left of the point M dividing the printed circuit board into the two portions, rather than at the right of the point M. The reason for this is that the respective thermal reaction properties of the left and the right portions of the printed circuit board 30 are different from each other, since the conventional printed circuit board 30 is not symmetrical about the line (phantom line of FIG. 2) passing through the point M.

[0058] Referring to Table 1 and FIG. 4, it may be seen that TCP 1 and TCP 8 experience the most misalignment. The amount of shrinkage of the PCB land groups 120a and 120h respectively corresponding to TCP 1 and TCP 8 needed to compensate for this misalignment can be determined from Table 1 and the graphs of FIG. 4. Hence, the shrinkage printed circuit board 100 is formed by positioning the land groups of the PCB so as to have respective constant intervals in each of the left portion and the right portion of the shrinkage printed circuit board 100, based on the shrinkage of the PCB land groups 120 a and 120h respectively corresponding to TCP 1 and TCP 8, as described in more detail below.

[0059] According to Table 1, the average misalignment of the regions where TCP 1 and TCP 8 are located are – 69.375 μm and 43.875 μm, respectively. Also, since the degree of misalignment in the left portion of the conventional printed circuit board 30 is greater than in the right

portion of the printed circuit board, as shown in FIG. 4, the PCB land group 120a corresponding to TCP 1 is shrunk toward the point M by about 66.5 μm, with a processing allowance of about 2.875 μm, and the PCB land group 120h corresponding to TCP 8 is shrunk by about 46.5 μm toward the point M, with a processing allowance of about 2.125 μm. Thus, the shrinkage printed circuit board 100 has a length of interest dimension that is shrunk by about 112.5 μm in comparison with that of the conventional printed circuit board 30.

[0060] Also, since the amount of thermal expansion of the left portion of the shrinkage printed circuit board 100 is greater than the amount of thermal expansion of the right portion thereof, which, as discussed above, is a result of the asymmetry of the shrinkage printed circuit board 100, the intervals between the respective PCB land groups are set at 19 μm in the portion of the PCB left of the point M and at 13 μm in the portion of the PCB right of the point M.

[0061] Hence, in accordance with one exemplary embodiment of the present invention, in order to improve the TCP lead group – PCB land group misalignment problem of the conventional PCB 30, the dimensions of the intervals between the land groups of the conventional PCB are shrunk as shown in FIG. 3A and described above, so that the shrinkage printed circuit board 100 has a length of interest dimension that is shrunk by 112.5 μm, as compared with the corresponding length of interest dimension of the conventional printed circuit board 30.

[0062] Referring to FIG. 3B, the TCP units 200 respectively corresponding to the PCB land groups 120 are fixed at respective edge portions of the TFT substrates 300 by interposing the ACF 250 therebetween. The ACF 250 is the medium that electrically connects the TCP units 200 to the TFT substrate 300. The TCP units 200 correspond to respective ones of the PCB land groups 120a through 120h, and starting at the left side of the figure, comprise first to eighth TCPs 200a through 200h.

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[0064] In this case, each of the TCPs 200a through 200h is disposed at a predetermined interval to align in the position, before each PCB land group 120a through 120h respectively corresponding to each of the TCPs 200a through 200h is shrunk.

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[0067] At that time, the PCB land groups 120a through 120h respectively move toward the left and the right ends of the substrate 110 centering around the point M according to the thermal expansion of the substrate 110 to compensate for the respective amounts of shrinkage that each PCB land group 120a through 120h was shrunk when the shrinkage printed circuit board 100 was manufactured. Thus, the degree of misalignment decreases during thermo-bonding, since each PCB land group 120a through 120h expands so as to move into alignment with its corresponding TCP 200.

[0068] For verifying the misalignment, the shrinkage printed circuit boards are measured after selecting ten shrinkage printed circuit boards at random and putting them through the thermo-compression bonding process described above. Each shrinkage printed circuit board has a thickness of about 0.45 mm and is thermo-compressed at a temperature of about 175° C under a pressure of about 3 MPa for about 20 seconds.

[0069] The directions of the left and the right thermal expansion of the left and right ends of TCPs 200a through 200h are different from the directions of thermal expansion of the substrate 110. Therefore, individual misalignment occurs to the left and right directions of the TCPs 200a through 200h. Therefore, the respective left misalignments of the TCP units 200 and the respective right misalignments of the TCP units 200 are independently measured, as shown in Table 2.

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[0073] Also, as described below, the total amount of thermal expansion of each tape carrier package is assumed to have a constant value (= 2β) that is independent of the expansion of either the shrinkage printed circuit board 100 or the conventional printed circuit board 30 during the thermo-compression bonding process.

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[0077] Referring to FIG. 5A, the direction of expansion of the left end of the first TCP 200a is identical to the direction of expansion of the shrinkage printed circuit board 100. However, the direction of expansion of the left end of the eighth TCP 200h is opposite to the direction of expansion of the shrinkage printed circuit board 100. FIG. 5B is a plane view illustrating the measurement of the misalignment of the A region in FIG. 5A. FIG. 5C is a plane view illustrating the measurement of the misalignment of the B region in FIG. 5A.

[0078] In FIG. 5B, a first real line 410 corresponds to the left end of the first PCB land group 120a in the pre-compression state and a second real line 510 corresponds to the left end of the first TCP 200a in the pre-compression state. Thus, the distance between the first real line 410 and the second real line 510 corresponds to the pre-adjustment made in the pre-compression state of the shrinkage printed circuit board 100 by shrinking the position of the first PCB land group 120a toward the point M, as described above.

[0079] When the thermo-compression process is performed on the first TCP 200a and the first PCB land group 120a, the left end of the first PCB land group 120a moves toward a first dotted line 420 due to the thermal expansion of the substrate 110 and the left end of the first TCP 200a also moves toward the second dotted line 520 for the same reason. Hence, after the thermo-compression bonding process, the first TCP 200a is expanded by an interval ($-\beta$) between the second real line 510 and the second dotted line 520. Also, the first PCB land group 120a expands by an interval (P_1) between the first real line 410 and the first dotted line 420. Then, the measured misalignment value becomes the interval (A_1) from the second dotted line 520 to the first dotted line 420.

[0080] In Table 2, since the left misalignment value of the first TCP 200a is – 28, the left end of the first PCB land group 120a is positioned at a position that is offset from the left end of the first TCP 200a by about 28 μm toward the left direction after thermal expansion of the substrate 100.

[0081] In FIG. 5C, the first real line 610 corresponds to the left end of the eighth PCB land group 120h in the pre-compression state and the second real line 710 corresponds to the left end of the eighth TCP 200h in the pre-compression state. Thus, the distance between the first real line 610 and the second real line 710 corresponds to the pre-adjustment made in the pre - compression state of the shrinkage printed circuit board 100 by shrinking the position of the eighth PCB land group 120h toward the point M, as described above.

[0082] When the thermo-compression process is performed on the eighth TCP 200h and the eighth PCB land group 120h, the left end of the eighth PCB land group 120h moves toward the first dotted line 620 due to the thermal expansion of the substrate 110, and the left end of the eighth TCP 200h also moves toward the second dotted line 720 due to the thermal expansion of

the substrate. Hence, after the thermo-compression bonding process, the eighth TCP 200h is expanded by an interval (– β) between the second real line 710 and the second dotted line 720. The eighth PCB land group 120h also expands by an interval (P_8) between the first real line 610 and the first dotted line 620. Also, the measured misalignment value becomes the interval (A_8) from the second dotted line 720 to the first dotted line 620.

[0083] In Table 2, since the left misalignment value of the eighth TCP 200h is 82, the left end of the eighth PCB land group 120h is positioned at a position that is offset from the left end of the eighth TCP 200h by about 82 μm in the right direction after thermal expansion of the substrate 110.

[0084]

[0085] The difference between the misalignment values measured at the respective left ends of the first TCP 200a and the eighth TCP 200h is regarded as the total amount of thermal expansion of the shrinkage printed circuit board 100 occurring during the thermo-compression bonding process.

[0086] FIGS. 6A, 6B, and 6C are plane views illustrating the presumption of the total amount of thermal expansion of the shrinkage printed circuit board 100 concerning the measured amounts of misalignment based on the respective right ends of the TCP units 200.

[0087] Referring to FIG. 6A, the direction of expansion of the right end of the first TCP 200a is opposite to the direction of expansion of the shrinkage printed circuit board 100. However, the direction of expansion of the right end of the eighth TCP 200h is identical to the direction of expansion of the shrinkage printed circuit board 100. FIG. 6B is a plane view illustrating the measurement of the misalignment of the C region in FIG. 6A. FIG. 6C is a plane view illustrating the measurement of the misalignment of the D region in FIG. 6A.

[0088] In FIG. 6B, the first real line 430 corresponds to the right end of the first PCB land group 120a in the pre-compression state and the second real line 530 corresponds to the right end of the first TCP 200a in the pre-compression state. Thus, the distance between the first real line

430 and the second real line 530 corresponds to the pre-adjustment made in the pre-compression state of the shrinkage PCB 100 by shrinking the position of the first PCB land group 120a toward the point M.

[0089] When the thermo-compression process is performed on the first TCP 200a and the first PCB land group 120a, the right end of the first PCB land group 120a moves toward the first dotted line 440 due to the thermal expansion of the substrate 110 and the right end of the first TCP 200a also moves toward the second dotted line 540 for the same reason. Hence, after the thermo-compression bonding process, the first TCP 200a expands by an interval (W1) between the second real line 530 and the second dotted line 540, and the first PCB land group 120a corresponding to the first TCF 200a expands by an interval (P1) between the first real line 430 and the first dotted line 440.

[0090] In Table 2, since the right misalignment value of the first TCP 200a is – 64, the right end of the first PCB land group 120a is positioned at a position that is offset from the right end of the first TCP 200a by about 64 μm in the left direction after thermal expansion of the substrate 110.

[0091] In FIG. 6C, the first real line 630 corresponds to the right end of the eighth PCB land group 120h in the pre-compression state and the second real line 730 corresponds to the right end of the eighth TCP 200h in the pre-compression state. Thus, the distance between the first real line 630 and the second real line 730 corresponds to the pre-adjustment made in the pre-compression state of the shrinkage PCB 100 by shrinking the position of the eighth PCB land group 120h toward the point M.

[0092] When the thermo-compression process is performed on the eighth TCP 200h and the eighth PCB land group 120h corresponding to the eighth TCP 200h, the right end of the eighth PCB land group 120h moves toward the first dotted line 640 due to the thermal expansion of the substrate 110 and the right end of the eighth TCP 200h also moves toward the second dotted line 740 for the same reason. Hence, after the thermo-compression bonding process, the eighth TCP 200h is expanded by an interval (W8) between the second real line 730 and the second dotted

line 740, and the eighth PCB land group 120h expands by an interval (P8) between the first real line 630 and the first dotted line 640. Also, the measured misalignment value becomes the interval (B_8) from the second dotted line 740 to the first dotted line 640.

[0093] In Table 2, since the right misalignment value of the eighth TCP 200h is 38, the right end of the eighth PCB land group 120h is positioned at a position that is offset from the right end of the eighth TCP 200h by about 38 μm in the right direction after the thermal expansion of the substrate 110.

[0094]

[0095] The difference between the misalignment values measured at the respective right ends of the first TCP 200a and the eighth TCP 200h is regarded as the total amount of thermal expansion of the shrinkage printed circuit board 100 occurring during the thermo-compression bonding process.

[0096] FIGS. 7A and 7B are plane views showing the relative position between the respective PCB land groups and the corresponding TCPs of Sample 1 in Table 2 after the thermo-compression bonding process. FIG. 7A is a plane view illustrating the alignment state between the first PCB land group and the first TCP 200a and FIG. 7B is a plane view showing the alignment state between the eighth PCB land group 120h and the eighth TCP 200h.

[0097] Referring to FIGS. 7A and 7B, the total amount of thermal expansion of the shrinkage printed circuit board 100 is directly obtained by taking the measured misalignment value of the eighth TCP 200h from the measured misalignment value of the first TCP 200a.

[0098] However, although the total amount of thermal expansion occurring in the shrinkage printed circuit board is obtained as above, the amount of thermal expansion on the left of the TCP unit differs from the amount of thermal expansion on the right of the TCP unit due to the asymmetry of the shrinkage printed circuit board 100 about the point M. Such difference may

cause minute differences in the spacing between the TCP units 200 and these spacing differences can cause processing errors.

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[0120] In the exemplary shrinkage printed circuit board 100 of the present invention, the intervals between the PCB land groups 120a to 120h respectively located at the left and the right portions of the substrate 110 centering around the point M are arranged so as to be different from one another, thereby maintaining the amount of misalignment generated in each of TCPs 200a through 200h constant. The amount of this constant misalignment is obtained in the following manner utilizing the measured data in Tables 2 and 4.

[0121] In Table 2, the amount of misalignment is measured on the basis of each edge of TCPs 200a through 200h for convenience of measurement. However, the precise amount of misalignment should be measured on the basis of each PCB land group 120a through 120h and the center of each corresponding lead group of TCPs 200a through 200h because misalignment here means an irregularity among the respective conductive patterns (*i.e.*, a misalignment between respective PCB land groups 120 and corresponding TCP 200 lead groups) that are used for exchanging the electrical signals between the printed circuit board 100 and the tape carrier packages 200.

[0122] Therefore, after the respective widths of each PCB land group 120a through 120h and the corresponding lead group of each TCP 200a through 200h are measured, the calculated misalignment values on the basis of the center of the lead group of each TCP 200a through 200h are presented in Table 7. In the samples of shrinkage printed circuit board 100 measured, the measured width of each PCB land group 120a to 120h and the measured width of each TCP lead group 200a to 200h are shown in the following Table 6.

[0123] As shown in Table 6, the measured width of each land group is obtained by measuring the real width of the PCB land group of each sample and the width of the lead group is obtained by measuring the real width of the lead group of the corresponding TCP of each sample.

The widths of the respective lead groups were found to vary only minutely, so that the respective widths of the lead groups can be treated as constants for all of the samples.

[0124] Thus, although the difference between the measured width of a land group and the width of the corresponding lead group (hereinafter, the width difference) is a quantity having no connection with the misalignment, the width difference is included in the measured misalignment value in Table 2. The measured misalignment values in Table 2 are obtained on the basis of each TCP 200a through 200h and each TCP 200a through 200h is thermally expanded in the left and the right directions centering around the point dividing each TCP 200a through 200h into two portions in the lengthwise direction of each TCP 200a through 200h. So two halves of the width difference are respectively included in the left and the right portions of each TCP 200a through 200h centering around the point dividing the lead group of each TCP into two portions in the lengthwise direction of the lead group of each TCP.

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[0126] The following Table 9 shows the misalignment values amended on the basis of the center of the lead group of each TCP by using the misalignment amounts measured on the basis of the end portions of each TCP in Table 4 according to the above-described method. In this case, the measured values of each PCB land group and each corresponding TCP lead group are presented in Table 8.

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[0130] Hence, the respective intervals among the PCB land groups at the left portion of the shrinkage printed circuit board 100 are set differently from the respective intervals among the PCB land groups at the right portion of the shrinkage printed circuit board 100, thereby maintaining the magnitudes of the misalignment generated in each TCP 200a through 200h to have constant values after the thermo-compression bonding process. Also, this prevents excessive thermal expansions of each TCP 200a through 200h generated by the accumulation of the respective thermal expansions thereof.

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[0146] At first, after the anisotropic conductive film (not shown) is attached to the data and the gate input pads, the output ends of the tape carrier packages 70 and 90 are positioned on the surface of the anisotropic conductive film, and then the surfaces of the tape carrier packages 70 and 90 are pressed by using a thermo-compression device. Thus, the gate and the data input pads and the output leads (not shown) of the tape carrier packages 70 and 90 are electrically connected while the anisotropic conductive film composed of the thermoplastic resin is completely compressed to the liquid crystal display panel 50 by the thermo-compression device.

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[0150] According to the present invention, when the PCB land groups are thermo-compressed with tape carrier packages by shrinking the PCB land groups of the printed circuit board by the thermal expansion of the printed circuit board, the misalignment between respective PCB land groups and corresponding TCP lead groups due to the thermal expansion of the printed circuit board can be decreased to secure a sufficient processing margin, so that productivity is improved by reducing the number of processing failures. Also, the amount of misalignment can be uniformly maintained so as to enhance the probability for controlling the misalignment and to increase the stability of the product.